

# COASTAL HERITAGE

VOLUME 31, NUMBER 2

SUMMER 2018



**Tank to Table**  
*How Single Oyster Mariculture Works*



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PHOTO/GRACE BEAHM ALFORD



*Coastal Science  
Serving South Carolina*

*Coastal Heritage* is a quarterly publication of the S.C. Sea Grant Consortium, a science-based state agency supporting research, education, and outreach to conserve coastal resources and enhance economic opportunity for the people of South Carolina.

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**NEW NICHE.** *The single-oyster mariculture industry is taking off in South Carolina, as hatcheries and farms refine methods for growing single oysters preferred by high-end restaurants.*  
PHOTO/GRACE BEAHM ALFORD

# Tank to Table

## *How Single Oyster Mariculture Works*

by Joey Holleman

**W**hen diners check out the chalkboard menu at The Obstinate Daughter on Sullivan's Island, they find an array of half-shell oyster choices. Aunt Dotty's from Massachusetts, Hatteras Salts from North Carolina, and Sea Clouds from South Carolina were their options in late April.

Ask the waitstaff where in South Carolina the Sea Clouds came from, and they might say Rockville or Wadmalaw Island, the location of the dock used by Barrier Island Oyster Company. But where they came from, at least in a genealogical sense, is a compact building in the shade of Spanish moss-draped live oaks on the edge of McCalley's Creek in Beaufort County. The vast majority of oysters

grown for the single half-shell mariculture industry in South Carolina during 2018 trace back to that building at Lady's Island Oyster – more specifically, to clear tanks that look like many small cookie jars in a row.

That's where oyster mariculture in South Carolina begins, as a female oyster pumps out millions of eggs, turning one of those containers into what looks like an oyster-lover's snow globe. In the next container, a male oyster releases enough sperm to turn the water from clear to cloudy.

Then oysters start the 12-to-18-month journey from conception in a hatchery to growth in natural creeks at one of more than a dozen farms in the state and finally to consumption by

diners in restaurants up and down the coast.

### **HATCHING A RENEWED OPTION FOR OYSTER HARVEST**

Lady's Island Oyster focuses on the raising of single oysters, the kind popular on the half shell at oyster bars, in a process termed mariculture. It's aquatic farming. Owner Frank Roberts' family has a long history of oyster harvesting in the Chesapeake Bay and Long Island Sound. After a law-enforcement career in Connecticut, Roberts settled in Beaufort County in the early 2000s and founded Lady's Island Oyster in 2007.

In many parts of the world, most





**LOCAL FLAVOR.** *The Lady's Island Oyster hatchery, on McCalley's Creek in Beaufort County, supplies seed oysters for mariculture operations throughout the state and region.*

PHOTO/JOEY HOLLEMAN, S.C. SEA GRANT CONSORTIUM

oysters harvested in the wild are singles. In the southeastern United States, however, several factors cause oysters to grow in clusters rather than easy-to-separate singles. Southeastern oysters are predominantly intertidal, meaning they are exposed to the air at low tide as compared to subtidal oysters in other regions that live continuously under water. Intertidal oysters tend to gather in clusters more than subtidal oysters do.

Also, the long period of warm water in the summer prompts oysters in the Southeast to spawn for a longer period and put out more larvae, called spat. When spat throughout the season attach to the hard surfaces of other oyster shells, they form clusters.

While an adept harvester with a claw device can separate ideal-sized

singles from a reef full of clusters – and a few along our coast make a living at it – the process is labor intensive. Instead, the standard South Carolina harvest method these days is to break off entire clusters and sell them in bushels.

Steam or roast a bushel or two of clusters over heat long enough for the shells to open, toss them on an outdoor table, and you have the oyster roast that has become the staple of Lowcountry gatherings.

So why go to the trouble of growing singles? Well, clusters straight off the boat sell for \$30 to \$40 a bushel, which depending on the size of the shells might contain 200 oysters. By contrast, maricultured singles can be sold by growers to restaurants for 75 cents to \$1 each, then priced at \$2

to \$4 apiece by the restaurants.

If the price per oyster were the only economic factor, people would be tripping over each other to farm single oysters. However, mariculture is complex. It requires special equipment and technology, dock space for land-based sorting, multiple regulatory licenses and permits, year-round attention to oyster cages in the “field,” and a new supply of seed oysters every year.

The high silt content in many South Carolina tidal creeks creates a particularly challenging environment for growing oysters. The industry first began to take off in the state with the advent over the past decade of off-bottom growing technology, basically cages of oysters designed to float high in the water column. In that nutrient-rich zone of the water column, single



oysters grow faster when not crammed into a space with too many other oysters competing for food.

Oyster mariculture in South Carolina faced a hurdle in 2014 when, amid concerns about disease transfer, the state placed a moratorium on seed oyster transfer from north of South Carolina. That's when Roberts decided to start a hatchery.

To grow seed oysters in a hatchery, water salinity and temperature have to be just right, and timing must be precise at each step in the process. "It's just like making a good wine," Roberts says. "It's an art."

Oysters thrive in the wild without this kind of precision. Each spawning female oyster might release several million eggs into a creek, and a nearby male oyster might push out several million sperm. Only a tiny percentage come together and become a larva, but this is enough for a healthy supply of oysters in the wild in South Carolina waters. The process in Roberts' hatchery is more efficient, aiming for 80 percent fertilization.

The hatchery process starts with broodstock, or male and female oysters selected as parents based on size and health. A single oyster primed to spawn is placed in each clear, cookie jar-sized tank in the hatchery to control the mixing of eggs and sperm.

You can't tell if oysters are male or female by just looking at them, and they can change between male and female at different stages of maturity, a trait called protandric hermaphroditism. In the hatchery, however, the current sex of each oyster becomes obvious soon enough.

The water flowing into the jars is gradually heated. In the wild, South Carolina oysters spawn when the water temperature hits about 68 degrees Fahrenheit. In the hatchery, they spawn when water temperature is raised by 10 degrees in a short period, replicating nature but compressing the time frame. At spawning, clear water turns cloudy for males and snow globe-like for females.

Roberts and his co-workers in the

hatchery watch for spawning and pour the female's eggs through a sieve that filters out debris and allows the eggs to flow into a large bucket. The sperm are filtered through a different sieve and into a separate bucket. Then some sperm are placed into the egg bucket.

Next comes the math. A pipette is used to draw from the egg bucket a one milliliter sample of water, which is placed on a microscope slide. Then the fertilized eggs in the water sample are counted through the microscope. A fertilized egg develops bumps which, viewed through a microscope, look like the ears on a Mickey Mouse hat, Roberts says. Multiply the number of Mickey Mouse hats in the microscope slide by the number of milliliters in the larger bucket, and you have an estimate of the number of fertilized eggs in the bucket.

If there are not enough eggs in the slide, more sperm need to be added to the egg bucket to improve the rate of fertilization. That's important because the recipe for feeding oyster larvae in the next phase is based on their density in the tank. A 250-gallon tank, for instance, can efficiently hold 20 million larvae at this early stage.

Now another ingredient is added:

food. Oysters are filter feeders, extracting microscopic organisms called plankton from the water through their gills. An individual adult oyster filters about 50 gallons of plankton-laden water a day. Early in the hatchery process, larvae are still at the stage when their growth requires strict control. Precisely measured portions of a microalgae concentrate, containing the same species a larval oyster would encounter in the wild, are added to the tanks.

After the larvae grow for about 48 hours, the water in the tank is run through a sieve to capture the larvae. Growth, health, and survival rate of larvae are assessed before they are returned to another tank of seawater.

The process is repeated every two days for about two weeks, by which time each larva should have developed a central dot that looks like an eye and a sticky foot-like appendage in need of a place to attach.

In the wild, oyster harvesters for centuries have known they need to return used shell to reefs to give those sticky feet a home base, or a substrate. At the hatchery, Roberts grinds oyster shells in a food processor to create hundreds of thousands of tiny pieces



**FOOTHOLD.** Grinding oyster shells in a food processor creates the fine shell particles, called microcultch, that serve as the home base for larvae to grow as a single oyster. PHOTO/CHRISTOPHER KATALINAS/NATIONAL SEA GRANT COLLEGE PROGRAM



called microcultch. Each of those shell pieces is just large enough for one larvae to attach to it. If the piece is too large, the result might be a mini-cluster instead of a single oyster.

A fine dusting of microcultch is put into mesh silos in a new tank, and then the eyed larvae are gently added. The sticky larval foot then attaches to the microcultch. As soon as larvae set, they rapidly build shell.

Each time the larvae move through a sieve into a new bucket, some don't survive. About 25 percent make it through the 12-18 days inside before moving to the covered porch

outside. There, the sieve screening continues, but the tiny oysters now filter natural plankton from water pumped directly from the creek.

After another three to four weeks of fattening up in nursery silos, seed oyster shells are 8-10 millimeters across, or about the diameter of a standard writing pen, and they are ready to be moved to the creeks. Roberts keeps some for his own farming operation. His remaining seed oysters are sold to other growers in South Carolina and neighboring states.

On pickup day, growers who have

contracted with Roberts pull their trucks under the live oak limbs and make typical farmer small talk about growing conditions, especially the weather. Roberts drains the water out of a silo, rinses the 20,000-30,000 seed oysters inside it into a cheesecloth bag about the size of a small cantaloupe, and hands them over to farmers such as Jared Hulteen of Barrier Island Oyster Company.

It's planting time.

## ENTREPRENEURS LEARN ABOUT FARMING INTRICACIES

Historians have uncovered evidence that human manipulation of the natural oyster growing process occurred more than 2,000 years ago, in both Chinese and Roman references. On the North American continent, however, wild oysters needed no help. Early European settlers reported massive oyster reefs in many natural harbors. Nearby on land they found middens, tall mounds of shells stacked by Native American tribes after repeated ceremonial feasts.

One of the largest intact shell middens along the South Carolina coast is on Fig Island, near Edisto Beach. Archaeological work has dated the middens to around 3,500-4,000 years ago. It was once on higher ground but is now surrounded by marsh.

Barrier Island Oyster Company's mariculture cages float a few hundred yards from the Fig Island middens. Hulteen wasn't aware of that proximity when he determined that this spot was ideal for growing oysters. He was cruising around in a boat with his wife and dog, scouting about a dozen potential sites, when he came around a beautiful bend in Ocella Creek.

"We came to this area and I said 'This is perfect!'" Hulteen says.

"It has plenty of flow on incoming and outgoing tides. And it's somewhat remote, not next to farms or golf courses or people in general, so the water's cleaner."

He also discovered that the water



**VOID FILLED.** Frank Roberts built the Lady's Island Oyster hatchery after state officials, responding to disease concerns, banned import of seed oysters from north of South Carolina.

PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT CONSORTIUM



salinity is ideal for growing tasty oysters. Water salinity is measured in parts per thousand (ppt), with open ocean water around 35 ppt and ideal oyster conditions in tidal creeks in the 14-28 ppt range. Also, the creek bottom in this section of the creek is firm, meaning less silt to choke oysters and a sturdy base for anchoring the cages.

Hulteen knows his way around shellfish. He used to work with the S.C. Department of Natural Resources in the S.C. Oyster Restoration and Enhancement program, which collects and plants recycled shells. Through the years, he noticed very few local singles were on menus in South Carolina restaurants.

"They could get singles from New England or the Pacific Northwest, but they couldn't get one of the salty, delicate local oysters," he says. "So I started researching."

He and business partner Josh Eboch began the lengthy process of seeking oyster mariculture permits in 2016 and put their first cages in Ocella Creek in March 2017. By March 2018, Barrier Island had 115 cages deployed at the site.

The company has permits for 220 more cages at a nearby site, but Hulteen and Eboch are moving slowly. They don't want to overcrowd the sites or take on more work than their four-man operation can handle as they learn the business. "We want to make sure it's done responsibly," Hulteen says.

The basics of off-bottom oyster mariculture are based on decades of trial and error. Coated metal cages with plastic floats are anchored in rows where creeks are deep enough for cages to stay under water at low tide but still be outside the main navigation channel. Each cage, about the size of a large bale of pine straw, has six compartments designed to hold individual plastic mesh bags filled with oysters. The oysters float high in the water column, where they can feed on the natural flow of plankton as tides move in and out of creeks.

Seed oysters start out in mesh bags



**FARM FIELD.** In off-bottom mariculture, floats keep cages filled with bags of single oysters near the surface, where nutrient-rich water flow is ideal for fast growth. PHOTO/GRACE BEAHM ALFORD

with openings small enough that none of the 8-10 mm shells will slip out. As oysters grow, farmers move them to bags with larger mesh and fewer oysters. It's critical at each stage to have the ideal volume of oysters in each bag. In an overfilled bag, oysters struggle to get enough nourishment, and some can die.

While cages might alter the pristine view of the creek for some boaters, the oysters' filter feeding actually helps keep the water clear. The goal is to make the farms compatible with nature. Boat traffic near floating oyster cages can improve the product because wake waves tumble the shells against one another, breaking off edges and creating more of a cup than a blade shape, Hulteen says.

The cages are connected by ropes attached to anchors. Only entrepreneurs who have risked their future on such a business can understand the sense of relief the Barrier Island team

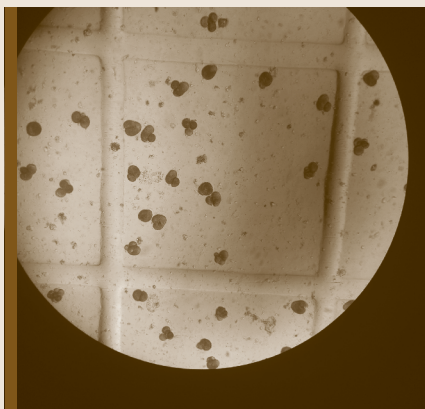
felt when those anchors held as Tropical Storm Irma pushed up the highest storm surge in the region in decades. Barrier Island and the other oyster farmers in the state were fortunate to make it through the storm without major problems.

The Barrier Island crew makes the 10-minute ride from a dock in Rockville to Ocella Creek several times a week in their boat, whimsically named Shell Raiser. They remove bags from a few cages and zip back to the dock to sort oysters before putting them back in the creek to continue growing. They use a homemade device they named Darth Grader to shake the smallest oysters into a pile separate from the slightly larger ones. Oysters are rebagged with others of similar size.

As oysters continue to grow, the sorting at the dock graduates to a tumbler, a rolling chute with holes that increase in size from one end to the other. When oysters tumble down the



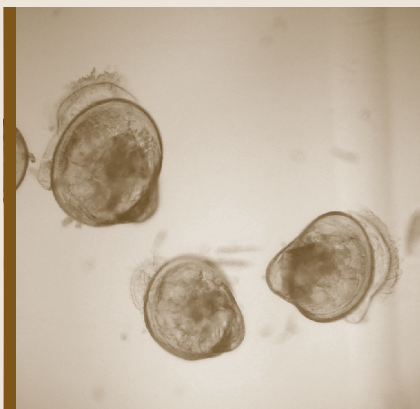
# THE LIFE OF A MARICULTURED OYSTER



## Day 1

Broodstock oysters spawn in separate containers in hatchery building; Sperm and eggs carefully combined to maximize fertilization; Microscope used to determine rate of fertilization of eggs.

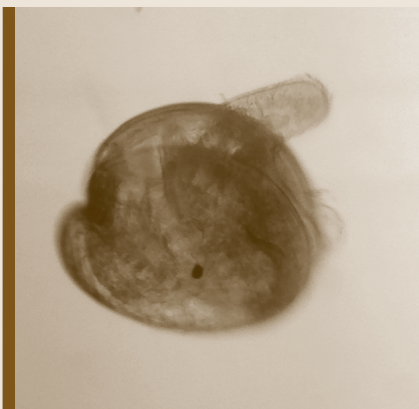
PHOTO/JULIE DAVIS/S.C. SEA GRANT CONSORTIUM



## Days 2-14

Larvae grow in controlled environment; Water strained through a sieve every two days to allow check on growth and health of larvae; A central dot, or eye, and sticky foot develop on larvae.

PHOTO/JULIE DAVIS/S.C. SEA GRANT CONSORTIUM



## Days 15-21

Eyed larvae placed in container with fine dusting of shell particles, called microcultch; Larvae attach via sticky foot to individual particles, creating single oysters; Shell production speeds up.

PHOTO/JULIE DAVIS/S.C. SEA GRANT CONSORTIUM

chute, smaller oysters fall through the holes. Those slower-growers are put back in bags and redeployed in the creek, allowing them more time to mature. Fast-growers rattle on down the chute and plop into a basket at the end. Individual oysters are dropped into a measuring device made of simple hose clamps tightened to measure three inches across. If the shell hangs over the edge of the clamp, it's ready to leave the farm.

About 5,000 seed oysters go in each of the first bags, or 30,000 in a six-bag cage. At the end of the growing process, each bag holds about 200 large oysters. Assuming only minimal oyster mortality during the year, a seed order of 30,000 that originally required only one cage will eventually require about 130 bags, nearly filling 22 cages.

That process can take a year for fast-growers, closer to 18 months for slow ones. Barrier Island began selling its first oysters in late fall 2017 while simultaneously preparing for the next season.

"We'd like to start planting new

seed as soon as it is ready for us," Hulteen says. "We get seed four times a year, and it's like crop rotation for us so all of our oysters don't become mature at once."

They branded their oysters Sea Clouds, a nod to the historic Sea Cloud Plantation on nearby Edisto Island. Their goal was to sell 700 oysters a week. But when they went to the first restaurant during their initial harvest week, the order was for 400. The next restaurant on the list wanted another 400. "It was scary," Hulteen says of the immediate demand.

The restaurant-sized oysters, for now, are kept cool in a small processing facility on James Island, where each oyster shell is cleaned by hand to ensure a product worthy of high-end restaurants. The goal is for oysters to be in restaurants within 24 hours of leaving the farm.

By late spring, orders were up to 3,000 per week, and the Barrier Island team was starting to think the business plan might work. Just as importantly, people seem to love the product. "Our

goal wasn't just to grow single oysters," Hulteen says. "We wanted to grow a great oyster. We've grown the oyster I hoped to grow."

## RESTAURANTS, DINERS WELCOME LOCAL SEAFOOD

Oyster lovers rival wine aficionados when it comes to flowery prose. Some of the best is by food writer Rowan Jacobsen. "Oysters taste like the sea," he writes in *A Geography of Oysters: The Connoisseur's Guide to Oyster Eating in North America*. "No other food does. Not lobsters, not saltwater fish, not scallops or clams or even kelp. Beef tastes meaty, milk tastes creamy, but the comparison for oysters is not a taste or another food but always a place. And a place – the seacoast – for which many of us have romantic associations. From oysters I learned that what's important about good food is not just what it gives you, but where it takes you."

Jacobsen's primer on the taste of oysters in his book is full of eloquent





### Days 22-60

Seed oysters moved to outside silos; Nutrient-rich creek water fuels growth to the 8-10 millimeter size suitable for planting in the wild; Farmers visit hatchery to pick up several thousands of seeds in each order.

PHOTO/CHRISTOPHER KATALINAS/  
NATIONAL SEA GRANT COLLEGE PROGRAM



### Months 3-18

Single oysters grow in mesh bags in floating cages in tidal creeks; Farmers remove bags routinely to control biofouling and re-sort by size; Oyster shells reach 3 inches long, an ideal size for restaurants.

PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT  
CONSORTIUM



### Final Days

Oyster shells cleaned and trucked to restaurants within 24 hours and stored in restaurant coolers at around 40 degrees; Small batches displayed in raw bar and ordered by the dozen by diners. Restaurant workers shuck oysters and serve with sauces.

PHOTO/GRACE BEAHM ALFORD

passages about sweet and savory, enzymes and amino acids, and the essence of deliciousness.

Jacobsen contends oysters, like wine, have a “somewhereness” to them based on the environment where they grow. The French term for this, *terroir*, is usually associated with wine. Water temperature, salinity, tide strength and variety, minerals in nearby marshes, and the type of algae that thrives in surrounding waters – all impact the taste of oysters.

Oysters are high in protein, vitamins, and beneficial omega-3 fatty acids, but low in saturated fat. A diner slurping down a half-dozen oysters takes in about 60 calories.

In the archives of the S.C. Historical Society, references on restaurant menus from Charleston events in the 1800s indicate oysters were popular, though local oysters in some cases were supplanted by products from the Northeast. The local Society of Cincinnati featured New York-grown “Blue Points on the Shell” on the menu for a February 22, 1893 event at

the St. Charles Hotel, but “Bull’s Bay Oysters” led the menu at its October 19, 1893 dinner at the Charleston Hotel.

By the latter half of the 1900s, local oysters in South Carolina restaurants were more likely to be fried, baked in a stew, or served in clusters straight off the roaster. By contrast, most oysters in raw bars were from the Northeast. But as the Charleston restaurant scene and local-food movement simultaneously exploded in the past decade, local half-shell oysters began to rise to star status.

Eboch and Hulteen, for instance, found willing buyers in restaurants like The Ordinary, 167 Raw, and The Obstinate Daughter.

“We’ve had a lot of oyster companies reach out to us,” says Will Fincher, chef de cuisine at The Obstinate Daughter on Sullivan’s Island. “At first, we went through the bigger purveyors, and oysters from outside the state were about all we could get.”

That was a problem for a restaurant that prides itself on South

Carolina-produced ingredients such as Anson Mills flour, Mepkin Abbey mushrooms, and Bulls Bay sea salt. With the growth of the single oyster industry in South Carolina, however, the raw bar menu some days lists nothing but locals.

Originally, the locals were limited to singles plucked from natural clusters, including Capers Blades by Dave Belanger, known as Clammer Dave, in McClellanville. Sea Clouds were the first local off-bottom maricultured oysters to hit the restaurant’s menu.

The Barrier Island team contacted Fincher and executive chef Jacques Larson as soon as their first harvest was ready, selling them on their clean appearance and unique taste. “They sat down with us and talked us through their process,” Fincher says. “They shucked some for us, and they were interesting and surprising.”

The mariculture process creates a deeper cup than wild oysters, storing more of the liquid, what’s referred to as liquor, around the oyster.

“Being able to hold the liquor



contributes a ton to the taste,” Fincher says. “They finish clean and don’t leave a dry after-taste.”

And taste is important. Oyster aficionados even created intricate flavor wheels as tools to categorize the taste, texture, and finish of each variety. Some hint at a melon flavor, some nutty, some smoky. Fincher smiles when discussing the topic, wondering if describing the taste of an oyster as similar to baby carrots or potato leek soup might be a stretch. But there’s no debating that each brand is unique.

“It’s really amazing how wildly different they taste, even if they are all grown locally,” Fincher says.

The Obstinate Daughter bit on Barrier Island’s initial sales pitch and now sells about 400 Sea Clouds each week. The oysters typically are delivered on a Thursday and stored in a cooler downstairs kept at 40-41 degrees Fahrenheit, cold enough to chill but not to kill. Raw oysters, after all, are alive until the bottom adductor muscle is severed during shucking.

About four dozen of three



**BOUNTIFUL HARVEST.** Hamlin Auld of Barrier Island Oyster Company empties a bag of oysters at the dock, where they will be cleaned and sorted by size, with the largest quickly landing in local restaurants.  
PHOTO/GRACE BEAHM ALFORD

## Oysters have long been important to South Carolina

Off-bottom oyster mariculture is just the latest trend in a long history of an industry extremely important to South Carolina’s history.

Shell middens that dot the coastline indicate natives consumed oysters in large quantities 3,500-4,000 years ago. Some of the first European settlers recognized the value of the potential oyster harvest and requested grants, from English kings and later provincial governments, to control shellfish grounds.

Oysters were the most valuable South Carolina fishery from the late 1880s until just after World War II, according to “The Oyster Industry in South Carolina,” a report written by Victor G. Burrell, Jr. in 2003. In 1902, for instance, oysters accounted for 45 percent of the value of all South Carolina seafood harvested.

Waterfront shucking houses and canneries were large operations, employing thousands, mostly African-Americans doing repetitive work for extremely low wages. Documents compiled by Burrell indicate 11 canneries and 31 shucking houses were operating in the state in 1926. As recently as 1985, there were 12 shucking houses in the state. But wage and employment laws, stricter permitting, and fewer healthy oyster beds made it increasingly difficult to make a profit shucking and canning oysters. The last of the large canneries in the state, run by the Maggioni family on Lady’s Island, shut down in 1986.

Oyster production in South Carolina remained above 600,000 bushels per year during the first six decades of the 1900s, and annual production hovered around 400,000 bushels in the decade before the last of the canneries closed. Since 1990, the annual commercial harvest has averaged about 94,500 bushels per year, with a low of 64,005 in 1998, according to the S.C. Department of Natural Resources. ♡





**TEMPTING DISPLAY.** *Caroline Campbell, sous chef at The Obstinate Daughter, places Barrier Island Oyster Company's Sea Clouds on ice, where diners can see their clean, cupped shells.*

PHOTO/GRACE BEAHM ALFORD

different varieties of oysters are brought up from the cooler and placed on ice in the restaurant every day. They sell for \$32-40 per dozen. Carefully shucked by restaurant staffers after being ordered, they come with a variety of sauces – lemon, cocktail, hot, and a special mignonette created to accentuate each variety's flavor. Hatteras Salts from North Carolina get a champagne mignonette, Aunt Dotty's from Massachusetts come with a watermelon mignonette, and Sea Clouds are paired with a tomato mignonette.

"The Sea Clouds are great," Fincher says. "We roll through them quickly. They're sold in only a few places, so they're a hot commodity."

So is the oyster mariculture industry as a whole. In 2016, Roberts sold

nearly 3 million seed oysters to growers in South Carolina and neighboring states. Assuming a modest survival rate, that translates into a wholesale value of \$1.8 million when the oysters are harvested a year or so later, and restaurant sales of nearly \$6 million. It's a healthy start.

The key for the future is to make it more than a short-term fad. And that requires work at every step of the process. Hatchery owners such as Roberts have to maintain quality broodstock and keep pumping out seed oysters. Farmers such as Barrier Island Oyster have to work their cages year-round to optimize growing conditions. Restaurants such as The Obstinate Daughter have to tout the unique flavor of the local product. And researchers need to keep refining the

best sustainable breeding and farming methods (see page 13).

While Lady's Island to Barrier Island to The Obstinate Daughter represents a linear route, the industry as a whole is more like the roots of an oak tree. Every root is different and important. Toogoodoo Oyster Company on Yonges Island, for instance, was the only farmer other than Roberts to grow its own seed in 2018, and owner Andrew Speaker is considering selling his seed oysters to other farmers in the future. Toogoodoo Oyster also takes a slightly different growth track, with a period spent in a controlled pond environment between hatchery and creek.

"I think it's the future of the food industry," Speaker says, referring to mariculture in general. "It's a great





**PALATE PLEASERS.** *Sea Clouds*, sold by the dozen, are shucked by restaurant employees and served in their shell cups with a sauce chosen to enhance the unique flavor.  
PHOTO/GRACE BEAHM ALFORD

source of food protein that enriches the environment.”

Brothers Austin and Andrew Harter at May River Oyster Company in Bluffton had enough faith in oyster farming to leave careers in the food and beverage industry three years ago and begin working the coastal waterways they have known their

entire lives.

“We’ve taken our lumps,” Austin Harter says. “They tell everybody who gets into this, ‘You’re going to kill some oysters,’ and we have.”

But they also harvested enough to supply restaurant diners at The Wyld in Savannah, Fishcamp on Broad Creek in Hilton Head Island, and

FARM in Bluffton. And they expect to add more customers in the coming years.

“The only thing holding it back is awareness,” Austin Harter says. “People just don’t know a lot about oyster farming. The potential is there to grow as more exposure is brought to the industry.” ♡



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# S.C. Sea Grant's assistance has been crucial for mariculture development in South Carolina

The S.C. Sea Grant Consortium continues to invest in the development of marine aquaculture to provide a safe and sustainable local seafood supply and support coastal business growth.

Over the past three decades, the Consortium has performed research and aided development efforts to foster aquaculture of marine shrimp, hybrid striped bass, and hard clams, and coordinated the creation of the state's first strategic plan for aquaculture development.

In 1984, Consortium staff worked with officials with the S.C. Department of Natural Resources (SCDNR), S.C. Department of Health and Environmental Control, the S.C.

Department of Agriculture, and other state and federal agencies to produce the *Interim Guide to Aquaculture Permitting in South Carolina*. The Consortium recently received Sea Grant funding to update the permitting guide to reflect changes in state and federal policies, laws, and regulations. SCDNR is working on an updated management plan, in part, to minimize conflicts between farms and other uses of the waterways.

Recently, the Consortium has focused its efforts on generating science-based information and providing assistance to the shellfish mariculture industry and natural resource agencies. The industry, which has grown from three to more than a dozen growers in the past four years, is meeting an increasing consumer demand for fresh and local shellfish.

The efforts have been coordinated by Julie Davis, the Consortium's Living Marine Resources Specialist. Davis provided technical assistance to Lady's



**Julie Davis**  
PHOTO/CHRISTOPHER  
KATALINAS/NATIONAL  
SEA GRANT COLLEGE  
PROGRAM



**SOLAR CLEANSING.** S.C. Sea Grant Consortium is leading a regional effort to determine the most effective schedule for flipping oyster cages to allow sunlight to reduce biofouling.

PHOTO/JULIE DAVIS/S.C. SEA GRANT CONSORTIUM

Island Oyster when its owner, Frank Roberts, sought to establish a seed oyster hatchery in response to the decision to halt importation of oyster seed from north of South Carolina in 2014. Lady's Island Oyster in 2018 was the only facility distributing seed to other shellfish growers throughout the state.

Work at Roberts' hatchery has led to the development of a spawnless, or non-reproducing, oyster that is naturally adapted to local conditions because it comes from "parents" native to South Carolina. The technical term for a spawnless oyster is triploid, meaning its genetic material is packaged on three sets of chromosomes. Diploid oysters have the same genetic material on two sets of chromosomes. Both triploids and diploids occur naturally, but triploids are very rarely found in the wild.

In oyster aquaculture, triploids are created using breeding techniques similar to those used to create seedless watermelons. Being spawnless, triploids have better meat quality in the warmer months than diploids, which must expend energy on reproduction. Consortium-funded research by

Peter Kingsley-Smith at the S.C. Department of Natural Resources also found that triploids grow slightly faster than diploids in South Carolina waters.

Davis also is leading a team of scientists and specialists from Texas to Virginia on a U.S. Department of Agriculture Southern Regional Aquaculture Center research project aimed at managing biofouling on oyster mariculture cages. Biofouling occurs when natural sea life such as barnacles and algae build up on the surface of cages, clogging the openings and preventing nutrient-rich water from flowing through the oysters.

Repeatedly turning the floating oyster cages upside down for a few hours exposes them to sunlight detrimental to biofouling creatures. The field experiments are designed to determine whether to flip cages once a week, every other week, or every three weeks.

Davis also has worked with Consortium staff to create an inventory management tool for use by growers, helping track which cages of oysters in large farm operations need to be checked on next. ♡



# NEWS & NOTES

## Marsh education program branches out

From Seeds to Shoreline® (S2S) usually ends, geographically, at the edge of the marsh. For three groups of students, however, the restoration effort expanded to beachfront dunes in 2018.

S2S is a student-based salt marsh restoration program coordinated by S.C. Sea Grant Consortium with partners at the S.C. Department of Natural Resources and Clemson University Cooperative Extension Service. Since the program's inception in 2011, S2S participants have transplanted thousands of *Spartina alterniflora* seedlings grown in school greenhouses to South Carolina marshes. *S. alterniflora* is the dominant grass in the state's salt-marsh environment as well as an ideal keystone species for understanding the rich estuarine environment it inhabits.

Teachers participating in S2S bring their students and seedlings to marsh settings at the end of the school year for restoration day field trips. Mike

Walker, an interpretive ranger at Huntington Beach State Park, has helped with S2S plantings at the park for years. After keeping a batch of seabeach amaranth (*Amaranthus pumilus*) seeds in his freezer for a decade, he asked horticulturist Kelley Nash at neighboring Brookgreen Gardens if she could germinate them.

Seabeach amaranth, once found along much of the eastern United States coastline, is a federally threatened species that grows in the wild only in South Carolina, North Carolina, and New York. Its habitat has been impacted by beachfront development and beach renourishment projects.

Nash worked her magic on the seeds, and U.S. Fish and Wildlife Service botanist April Punsalan provided expertise and assisted with obtaining federal permits to allow the planting.

Walker had dozens of seedlings ready to plant in May 2018.

Groups from three Georgetown and Horry county schools – Carolina Forest High School, Ocean Bay Middle School, and Coastal Montessori

Charter – headed from the marsh to the beach at the end of their restoration days. They dug holes in the loose sand at the foot of dunes near a park walkover, added water, and placed the seabeach amaranth roots in the holes.

Seabeach amaranth grows closer to the open ocean than any other vascular plant, yet its stalks are delicate, Walker said.

He and Nash asked the students to gently pile sand slightly up the stalks to give extra support.

Just as *Spartina* root systems help protect the edges of marshes from erosion, seabeach amaranth roots help collect sand important to dune-building. Unlike *Spartina*, which is a rugged perennial grass that can survive for years, the seabeach amaranth is an annual plant. The seedlings planted in May won't survive through the end of the year. But if they make it long enough to disperse seeds into the wind, those seeds could grow into new amaranth in 2019. ♡

## McClellanville looks at waterfront options

The seafood industry is the lifeblood of the small South Carolina town of McClellanville, but the people who have managed the processing and distribution of the catch for decades are aging and the future of their docks is in doubt.

That's what brought about 30 people together on April 24, 2018 at McClellanville Town Hall to discuss future options, including the potential for a fishing cooperative.

"It's time to plan for the next thing," said Thomas Beckett, executive director of Carolina Common Enterprise. "It's time to find a way to continue to do what you already do very well."

The two-hour session was the second in a series of meetings funded by a Hometown Economic Development Grant awarded by the Municipal Association of South Carolina to the town and its partners, S.C. Sea Grant Consortium, East Cooper Land Trust, and Carolina



Students from Ocean Bay Middle School helped plant seabeach amaranth seedlings in the dunes at Huntington Beach State Park. PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT CONSORTIUM



# NEWS & NOTES

Common Enterprise.

Beckett's organization researched how fishing cooperatives work in other locales and met with local stakeholders to learn the intricacies unique to McClellanville. He intends to put together potential business plans.

The local industry has some hurdles in its future. The largest of two commercial docks, Carolina Seafood, has been managed by owner Rutledge Leland since 1972. Leland can't go on forever, and nobody has stepped forward to buy his business.

Bill and Kathy Livingston, owners of the smaller dock at Livingston's Bulls Bay Seafood, also are from Leland's generation. While their son-in-law, Jeff Massey, has assumed some of the management responsibilities for the dock, the future of their business in that location is far from certain.

Boat captains at the meeting were searching for some hope for a stable distribution future in McClellanville. That's the key to maintaining the fishing village's cultural identity, they said.

The cooperatives Beckett discussed, Walking Fish in North Carolina and Heritage Shellfish in New Jersey, take varied approaches. Walking Fish is a community-supported fishery in which a few members pre-pay for a season of seafood. Heritage Shellfish was formed by three clam harvesters to market their product under the Eventide Littlenecks brand.

An option for a cooperative in McClellanville could feature aspects of both of those business plans. Seafood with an official McClellanville brand could draw higher prices in local restaurants and retail stores. Or maybe a pre-pay version supported by select restaurants would work.

Cooperatives typically hire someone to handle the supply logistics, something Leland and the Livingstons now do. Leland is convinced the best way forward is to freeze more of the product straight off the boats. Shrimp, for instance, often are caught in large quantities over short periods of time. Freezing some of the large hauls allows distributors to stretch out sales over several months rather than forcing the quick turnover of perishable fresh inventory. Leland has minimal freezer space at Carolina Seafood. He suggested that a larger freezing facility could be a key to keeping McClellanville's seafood industry healthy.

Some boat captains noted that the priority should be keeping the local docks open. They fear the waterfront property would be desirable for high-end residential development.

On that topic, Catherine Main, executive director of East Cooper Land Trust, suggested the possibility of purchasing a cultural conservation easement on the Carolina Seafood property. In such an arrangement, a land owner puts restrictions on the future use of property. In return for those restrictions, the property owner is paid or gets tax deductions. Under the right circumstances, Leland said, he would consider an easement.

Even if the dock space is assured, however, somebody will have to run the business. Julie Davis, S.C. Sea Grant Consortium's living marine resources specialist, suggested treating the situation as if writing a real estate ad or posting a help-wanted ad for a job. Stress the positives: historically strong community support, a product people want to buy, suppliers willing to do the hard work to obtain the product, and a great view from the office window.

If the dock's future can be worked out, would someone capable of running a seafood distribution business be intrigued enough by that description to take on the acknowledged challenges in McClellanville? ✓

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## Narayana, Moylan join Consortium staff

Two new staff members have joined the S.C. Sea Grant Consortium – Crystal Narayana as web developer and graphic artist and Shaun Moylan as information technology resources manager.



**Crystal Narayana**

PHOTOS/SUSAN FERRIS HILL/S.C. SEA GRANT CONSORTIUM



**Shaun Moylan**

Narayana, who has a B.A. degree in Linguistics from Ohio State University, began her career as web developer and graphic designer for Arc of Appalachia, a regional nature conservation organization based in Ohio. She eventually served as their program director, facilitating and promoting education events. More recently, she worked with multiple clients as a web developer for NuGrowth Solutions.

Moylan, who has a B.S. degree in Information Systems and Decision Sciences from Louisiana State University, has 11 years of IT management experience. During that time, he handled IT support, planning, security, implementation, and disaster recovery for companies in the hospitality industry. ✓





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# EBBS & FLOWS

## **Carolinas Climate Resilience Conference**

*Columbia, South Carolina  
September 17-19, 2018*

Building resilience, the ability to adjust easily to or recover from a stress or change, is the focus. The conference provides a platform for researchers and staff members from local, state, and federal agencies to share experiences, tools, resources, and expertise to foster real-world solutions for climate adaptation in the Carolinas.

For more information, visit  
[www.cisa.sc.edu/ccrc](http://www.cisa.sc.edu/ccrc).

## **South Carolina Water Resources Conference**

*Columbia, South Carolina  
October 17-18, 2018*

The conference provides a forum for discussion of water policies, research projects, and water management. Sessions will focus on how advances during the past 10 years are expected to impact the ongoing challenge of providing water resources to sustain the state's economy.

Visit [www.clemson.edu/public/sc\\_water\\_resources](http://www.clemson.edu/public/sc_water_resources) for more information.

## **OCEANS 2018 Conference and Exposition**

*Charleston, South Carolina  
October 22-25, 2018*

The bi-annual forum brings together scientists, engineers, policy analysts, marine technologists, and students to learn about and discuss the latest topics and trends in marine science, technology, and policy. The goal is to advance the protection of the world's largest natural resource, our oceans.

For more information, visit [www.charleston18.oceansconference.org](http://www.charleston18.oceansconference.org).

**Subscriptions are free upon request by contacting: [Joey.Holleman@scseagrant.org](mailto:Joey.Holleman@scseagrant.org)**

**ATTENTION SCHOOL TEACHERS!** The S.C. Sea Grant Consortium has designed supplemental classroom resources for this and past issues of *Coastal Heritage* magazine. *Coastal Heritage Curriculum Connection*, written for K-12 educators and their students, is aligned with the South Carolina state standards for the appropriate grade levels. Includes standards-based inquiry questions to lead students through explorations of the topic discussed. *Curriculum Connection* is available online at [www.scseagrant.org/education](http://www.scseagrant.org/education).

Total printing cost: \$2,399 • Total number printed: 5,500 • Cost per unit: \$.44